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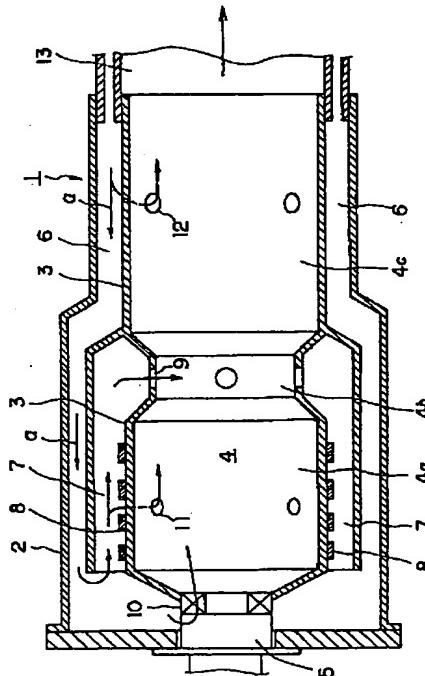
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(54)【発明の名称】 ガスターピン燃焼器

(57)【要約】

【課題】低カロリー燃料を使用する場合ガスターピン燃焼器においては、燃焼ガスの低NO_x化を図ることを可能にするとともに、一次燃焼域を形成する燃焼器ライナの壁面を効果的に冷却できるようにする。

【解決手段】燃焼器ライナ3の一次燃焼域4aに沿って下流端側を袋路状態に塞ぎ、上流端側を開口する冷却通路7を設け、また冷却通路7に隆起部8を突設し、冷却空気に乱流を促し、冷却性能を向上させる。



【特許請求の範囲】

【請求項1】 フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過濃状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に、上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域に沿って下流端側を袋路状に塞ぎ、上流端側を開口する冷却通路を設けたことを特徴とするガスタービン燃焼器。

【請求項2】 冷却通路の内部両周壁面側のうち、少なくとも一周壁面側には隆起部を突設したことを特徴とする請求項1記載のガスタービン燃焼器。

【請求項3】 フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過濃状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に、上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域に沿って上流端側および下流端側を袋路状に塞ぐとともに、外周壁面に噴口部を有する冷却通路を設けたことを特徴とするガスタービン燃焼器。

【請求項4】 フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過濃状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に、上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域および上流絞り部に沿って一端側を袋路状に塞ぐとともに、他の一端側をヘッドプレートに固設した外周筒と、この外周筒と上記燃焼器ライナとの間に収容され、一端側を、上記袋路状に塞がれた外周筒に穿設した冷却空気導入口に連通し、他の一端側を開口する冷却通路と、この冷却通路に横断して上記燃焼器ライナの二次燃焼域に燃焼空気を案内する二次燃焼空気筒と、上記燃焼器ライナの一次燃焼域の上流側に形成された副燃焼室と、この副燃焼室にまで延び上記ヘッドプレートに装着されたパイロット燃料ノズルと、上記外周筒と上記冷却通路との間に設けられ、上記燃焼器ライナの二次燃焼域に希薄燃料を送給するメイン燃料ノズルとを有する構成としたことを特徴とするガスタービン燃焼器。

【請求項5】 外周筒と燃焼器ライナとの間に収容された冷却通路の内部両周壁面側のうち、少なくとも一周壁面側には隆起部を突設したことを特徴とするガスタービン燃焼器。

【請求項6】 フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過密状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断

面積を有する絞り部を備え、この絞り部に上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域および上流絞り部に沿って一端側を袋路状に塞ぐとともに、他の一端側をヘッドプレートで塞がれた外周筒と、この外周筒と上記燃焼器ライナとの間に収容され、一端側を、上記袋路状に塞がれた外周筒に穿設した冷却空気導入口に連通し、他の一端側を開口する冷却通路と、この冷却通路に横断して上記燃焼器ライナの二次燃焼域に燃焼空気を案内する二次燃焼空気筒と、上記燃焼器ライナの一次燃焼域の上流側に形成された副燃焼室と、この副燃焼室にまで延び上記ヘッドプレートに装着されたパイロット燃料ノズルと、上記外周筒と上記冷却通路との間に設けられ、上記燃焼器ライナの二次燃焼域に希薄燃料を送給するメイン燃料ノズルとを有する構成としたことを特徴とするガスタービン燃焼器。

【請求項7】 副燃焼室には、パイロット燃料ノズルから噴出する燃料に旋回流を与える副スワーラと、上記副燃焼室から出る燃焼ガスに旋回流を与える主スワーラとを備えたことを特徴とする請求項6記載のガスタービン燃焼器。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、ガスタービン燃焼機に係り、とりわけ低カロリーの燃料を用いて燃焼ガスを生成するに好適なガスタービン燃焼器に関する。

【0002】

【従来の技術】 一般に、ガスタービン燃焼器から生成される燃焼ガスには、燃焼空气中に含まれる窒素に起因するサーマルNO_xと、燃料中に含まれる窒素に起因するフューエルNO_xがある。とりわけ、燃料中にアンモニア等の窒素が多く含まれていると、燃焼ガス中のNO_x分の比率が高くなっている。

【0003】 近時、化石燃料の枯渋を配慮して、低カロリー燃料、例えば石炭をガス化状態にしてガスタービン燃焼器の燃料に使用する研究がこの種分野で多く進められているが、何分にもその燃料には多くの窒素分が含まれていることによってフューエルNO_xの低減が難しくなっている。

【0004】 このフューエルNO_x低減技術として諸外国の文献、例えばアメリカ機械学会の文献、83-GT-14、83-GT-108（いずれも1983年ASM発行）に見られるように、一つの燃焼室で比較的の燃料過濃状態の一次燃焼域と比較的の燃料希薄状態の二次燃焼域とに使い分けるRich-Lean燃焼法や、燃焼室に保炎を目的として新たに副燃焼室を設け、この副燃焼室で燃焼ガスを生成する際、当量比（理論空気量に対する燃料量の占める割合）を従来よりも高くする技術が従来から良く知られている。

【0005】 しかし、ガスタービン燃焼器が上記Rich-

Lean燃焼法、あるいは副燃焼室での燃焼法のいずれの燃焼法を採用するにせよ、燃料自体が低カロリーであってみれば、高カロリー燃料を使用して良質の燃焼ガスを生成するのと同一レベルまで引き上げるには、低カロリー燃料を多量に使用し、燃焼室の一部分を燃料過濃状態にしておく必要がある。

【0006】ところが、燃焼室の一部分を燃料過濃状態にしておく場合、燃焼ガス生成の際、それ自体が高温化されるために、高混化に対処した燃焼室の冷却技術が求められている。

【0007】図5は、燃焼室の冷却を考慮したガスタービン燃焼器を示す概略図である。

【0008】符号1はガスタービン燃焼器を示す。このガスタービン燃焼器1は、図示しない圧縮機とガスタービンとの間に位置し、圧縮機からの高圧空気へ燃料が加えられて燃焼ガスを生成するものであり、生成された燃焼ガスを、作動ガスとしてトランジションピース13を介してガスタービンに供給するものである。

【0009】ガスタービン燃焼器1は、図5に示されているように、筒状のフロースリーブ2と、これに同軸的に収容された筒状の燃焼器ライナ3とを備えている。

【0010】筒状の燃焼器ライナ3は、燃焼室4を内部に形成する。この燃焼室4の上流から順に燃料過密状態の下で燃焼ガスを生成する一次燃焼域4aと、燃料希薄状態の下で燃焼ガスを生成する二次燃焼域4cと、これら両燃焼域4a、4cの横断面積よりも小さな横断面積の絞り部4bとを有する構成になっている。

【0011】また、燃焼器ライナ3の頭部側には、燃料ノズル5が装着され、ここから低カロリー燃料がスワーラ10からの旋回空気へ混合し、燃焼ガスとして一次燃焼域4aに向って噴出している。

【0012】上記フロースリーブ2と上記燃焼器ライナ3との間には、図示しない圧縮機からの高圧空気を案内する燃焼空気通路6が形成されている。

【0013】このような構成のガスタービン燃焼器1において、燃焼空気通路6に案内された高圧空気は、燃焼ガス生成の燃焼空気として、また燃焼器ライナ3の冷却空気として使用されている。

【0014】すなわち、燃焼空気通路6に案内された高圧空気のうち、燃焼空気は、図示実線矢印aのように、一次燃焼域4aの上流側に向って進む途中で、二次燃焼域4cの希釈空気口12において、燃焼ガス温度をガスタービンの作動ガスに適した温度に下げるために使用され、また、絞り部4bの二次空気口9において、未燃燃料の燃焼を促すために使用され、さらに一次燃焼域4aの一次空気口11において、過濃燃料の燃焼を促すために使用され、さらにまた一次燃焼域4a頭部のスワーラ10において、燃料ノズル5からの燃料に旋回流を与えて霧化するためにそれぞれ使用されていた。その一方で、燃焼空気aは、燃焼器ライナ3の壁面に沿って流

れ、加熱状態にある燃焼器ライナ3を保護するために使用され、対流冷却等によって冷却し、保護していた。

【0015】

【発明が解決しようとする課題】ところで、最近のガスタービンは、高熱効率化を目指し、その一環としてガスタービン燃焼器の燃焼ガス温度の高温化が模索されている。燃焼ガスの高温化に伴い、ガスタービン燃焼器では、限られた燃焼空気源であってみれば、上述燃焼ガスの生成を促すに必要な燃焼空気の使用に比重が置かれ、燃焼器ライナを冷却するに必要な冷却空気の使用に占める割合が減少している。とりわけ、低カロリー燃料を使用するガスタービン燃焼器では、高カロリー燃料を使用するガスタービン燃焼器の燃焼ガス温度と同一レベルに維持するために、多量の燃料を必要とし、これに伴って燃焼ガスの生成に必要な燃焼空気量も増加し、この増加と反比例して冷却空気量が低下し、この低下した冷却空気量の下で上述加熱状態にある燃焼器ライナを保護することは困難である。

【0016】

【0016】また、低カロリー燃料を使用するガスタービン燃焼器であっても、起動運転終了までは、燃焼ガス生成の安定性から灯油、軽油、LNG等の高カロリー燃料が使用されるが、この高カロリー燃料の使用中に生成される燃焼ガスには多くのNO_xが含まれている。このNO_x低減策として、従来から燃料ノズルから噴出する燃料に、水または蒸気を噴射し、生成中の燃焼ガス温度を下げるようになっていたが、多量の水または蒸気を使用する関係上、発電所全体の所内熱効率を考えると、経済的に得策とは言えない。

【0017】

【0017】本発明は、このような事情に鑑みてなされたので、低カロリー燃料を使用する場合、今以上に加熱状態に晒される燃焼器ライナを、限られた冷却空気源の下、効果的な冷却を行なうことによって確実に保護するとともに、生成燃焼ガス中に含まれるNO_xの効果的な低減を図ったガスタービン燃焼器を提供すること目的とする。

【0018】

【課題を解決するための手段】本発明に係るガスタービン燃焼器は、上記目的を達成するため、フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過濃状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に、上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域に沿って下流端側を袋路状に塞ぎ、上流端側を開口する冷却通路を設けたものである。

【0019】

【0019】本発明に係るガスタービン燃焼器は、フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過濃状態で

燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に、上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域に沿って上流端側および下流端側を袋路状に塞ぐとともに、外周壁面に噴出口部を有する冷却通路を設けたものである。

【0020】本発明に係るガスタービン燃焼器は、フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過濃状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に、上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域および上流絞り部に沿って一端側を袋路状に塞ぐとともに、他の一端側をヘッドプレートに固設した外周筒と、この外周筒と上記燃焼器ライナとの間に収容され、一端側を、上記袋路状に塞がれた外周筒に穿設した冷却空気導入口に連通し、他の一端側を開口する冷却通路と、この冷却通路に横断して上記燃焼器ライナの二次燃焼域に燃焼空気を案内する二次燃焼空気筒とを有する構成にしたものである。

【0021】本発明に係るガスタービン燃焼器は、フロースリーブ内に同軸的に収容された燃焼器ライナを有し、この燃焼器ライナの上流側から順に燃料過密状態で燃焼する一次燃焼域と、燃料希薄状態で燃焼する二次燃焼域とを形成する一方、これら両燃焼域間に、それぞれの燃焼域の横断面積よりも小さな横断面積を有する絞り部を備え、この絞り部に上記二次燃焼域に燃焼空気を送給する空気口を穿設したガスタービン燃焼器において、上記燃焼器ライナの一次燃焼域および上流絞り部に沿って一端側を袋路状に塞ぐとともに、他の一端側をヘッドプレートで塞がれた外周筒と、この外周筒と上記燃焼器ライナとの間に収容され、一端側を、上記袋路状に塞がれた外周筒に穿設した冷却空気導入口に連通し、他の一端側を開口する冷却通路と、この冷却通路に横断して上記燃焼器ライナの二次燃焼域に燃焼空気を案内する二次燃焼空気筒と、上記燃焼器ライナの一次燃焼域の上流側に形成された副燃焼室と、この副燃焼室にまで延び上記ヘッドプレートに装着されたパイロット燃料ノズルと、上記外周筒と上記冷却通路との間に設けられ、上記燃焼器ライナの二次燃焼域に希薄燃料を送給するメイン燃料ノズルとを有する構成としたものである。

【0022】

【発明の実施の形態】以下、本発明に係るガスタービン燃焼器の一実施の形態について図1により説明する。

【0023】符号1はガスタービン燃焼器を示す。このガスタービン燃焼器1は、図示しない圧縮機とガスター

ビンとの間に位置し、圧縮機からの高圧空気に燃料が加えられて燃焼ガスを生成するものである。ガスタービン燃焼器1により生成された燃焼ガスは、ガスタービンに案内され、ここで静翼・動翼で構成される段落部により膨張仕事をして回転エネルギーを得るものである。

【0024】ガスタービン燃焼器1は、図1に示されるように、フロースリーブ2と、これに同軸的に収容された燃焼器ライナ3を備えている。

【0025】燃焼器ライナ3は、燃焼室4を内部に形成する。この燃焼室4は、上流側から順に燃料過濃状態の下で燃焼ガスを生成する一次燃焼域4aと、燃料希薄状態の下で燃焼ガスを生成する二次燃焼域4cと、これら両燃焼域4a、4cの横断面積よりも小さな横断面積の絞り部4bとを有する構成になっている。

【0026】また、燃焼器ライナ3の頭部側には、燃料ノズル5が装着され、ここから低カロリー燃料、例えば石炭ガス化燃料が一次燃焼域4aに向って噴出している。

【0027】上記フロースリーブ2と上記燃焼器ライナ3との間には、図示しない圧縮機からの高圧空気を案内する燃焼空気通路6が形成されており、この燃焼空気通路6内であって、上記燃焼器ライナ3の一次燃焼域4aに沿って下流端側を袋路状に塞ぎ、上流端側を開口する冷却通路7が設けられている。

【0028】冷却通路7は、燃焼器ライナ3の絞り部4bまで延び、この間、内部両周壁面側の少なくとも一周壁面側に隆起部8を備えるとともに、下流端側に、上記絞り部4bに連通し、燃焼空気を上記二次燃焼域4cに案内する二次空気口9を備えている。

【0029】上記冷却通路7を備えたガスタービン燃焼器1において、燃料ノズル5から低カロリー燃料が一次燃焼域4aに向って噴出し、噴出した燃料にスワーラ10からの燃焼空気が加わって旋回流が与えられ、さらに一次空気口11からの燃焼空気が加わって燃焼ガスが生成される。

【0030】ところが、一次燃焼域4aでは、燃料過濃状態で燃焼ガスが生成されているため、一次燃焼域4aを形成する燃焼器ライナ3の内外周壁面は、高温燃焼ガスの熱をまともに受け、過酷な状態に晒されている。

【0031】このような状態下にある燃焼器ライナ3において、図示しない圧縮機から燃焼空気通路6を経て送給される冷却空気としての燃焼空気aは、図示実線矢印で示されるように、冷却通路7に案内され、隆起部8で衝突させ、その流れに乱れを与えた対流冷却により燃焼器ライナ3からの熱を奪うようしている。そして、燃焼器ライナ3からの熱を奪った燃焼空気aは、二次空気口9から絞り部4bを経て二次燃焼域4cに案内され、ここで燃焼空気通路6から希釈空気口12を経て案内された冷却空気としての燃焼空気とともに比較的低温の燃焼ガスを生成し、生成燃焼ガスをトランジションピース

13を経て図示しないガスタービンに送給されるようになっている。

【0032】したがって、本実施の形態に係るガスタービン燃焼器1では、一次燃焼域4aが低カロリー燃料を使用し、燃料過濃状態であるが故に高温燃焼ガスに晒されている燃焼器ライナ3であっても、冷却通路7により、また、隆起部8により対流冷却を引き起させて燃焼器ライナ3の熱を奪うことができるので、その燃焼器ライナ3の材力強度を十分に維持して高温燃焼ガスを生成することができる。

【0033】図2は、本発明に係るガスタービン燃焼器の他の実施の形態を示す概略図である。

【0034】本実施の形態は、第1の実施の形態である冷却通路7の対流冷却に代えてインピング冷却ができるようにしたものである。

【0035】詳述すると、この冷却通路7は、燃焼器ライナ3の一次燃焼域4aに沿って上流端側および下流端側を袋路状に塞ぐ密室にしたものであって、この密室の外周壁面側に噴口部14を設けたものである。なお、他の構成は、第1実施の形態と同様なのでその説明を省略する。

【0036】上記噴口部14を備えた冷却通路7において、燃焼空気通路6からの冷却空気としての燃焼空気aは、噴口部14を経て燃焼器ライナ3の壁面に噴流衝突(インピング)し、噴流衝突の際に燃焼器ライナ3の熱を奪っている。そして、燃焼器ライナ3の熱を奪った燃焼空気aは加温され、ここから絞り部4bの二次空気口9を経て二次燃焼域4cに供されている。

【0037】このように冷却通路7では、燃焼空気aの噴流衝突というインピング冷却が行なわれるので、第1実施の形態である対流冷却よりも熱伝達率が高い点で冷却性能が向上し、燃焼器ライナ3の材力強度を確実に維持することができる。

【0038】図3は、本発明に係るガスタービン燃焼器の他の別の実施の形態を示す概略図である。

【0039】本実施の形態は、燃焼空気通路6からの冷却空気としての燃焼空気aを迂回することなく直接、冷却通路7に案内する点で第1実施の形態と異なっている。

【0040】すなわち、図にも示されるように、燃焼器ライナ3の一次燃焼域4aおよび絞り部4bに沿って外周筒15が設けられている。この外周筒15は、一端側を袋路状に塞がれ、他の一端側をヘッドプレート16に固定した筒状のものである。

【0041】この筒状の外周筒15には、燃焼器ライナ3の一次燃焼域4aおよび絞り部4bに沿う冷却通路7が同軸的に収容されており、この冷却通路7は上記袋路状に塞がれた外周筒15に穿設した冷却空気導入口17により燃焼空気通路6と連通するようになっている。また、冷却空気通路7には、その内部両壁面側のうち、少

なくとも一壁面側に隆起部8が突設されている。また、冷却通路7には、燃焼器ライナ3の壁面を冷却した冷却空気を迂回させて二次燃焼域4cに案内する二次燃焼空気筒18が横断的に設けられている。

【0042】このような流路構成の冷却通路7は、燃焼空気通路6からの冷却空気としての燃焼空気aを冷却空気として冷却空気導入口17を経て案内し、ここで隆起部8との干渉による流れの乱を促す対流冷却がなされ、燃焼器ライナ3の壁面を冷却後、反転し、二次燃焼空気筒18から二次燃焼域4cに供給されるようになっている。

【0043】したがって、この冷却通路7では、燃焼空気通路6からの燃焼空気aを冷却空気として用いる場合、冷却空気導入口17で増速されて熱伝達率が高まり、さらに、隆起部8の乱流作用により熱伝達率が格段に向上し、燃焼器ライナ3の壁面冷却を一段と高く冷却することができる。

【0044】図4は、本発明に係るガスタービン燃焼器の他の別の実施の形態を示す概略図である。

【0045】本実施の形態は、一次燃焼域4aの上流側に副燃焼室4dを設けるとともに、この副燃焼室4dにパイロット燃料ノズル19を装着することにより、一次燃焼域4aの燃焼ガスを保炎的に機能させ、また外周筒15と冷却通路7との間にメイン燃料ノズル20を設け、二次燃焼域4cに燃料に空気を加えた混合体としての予混合燃料を送給するようとしたものである。

【0046】すなわち、一次燃焼域4aの上流側には、副燃焼室4dが設けられている。この副燃焼室4dは、略箱状に形成された空間部を有し、ヘッドプレート16で保持されたパイロット燃料ノズル19が装着できるようになっている。また、副燃焼室4dはパイロット燃料ノズル19の外周側に副スワーラ22を設けるとともに、その副スワーラ22の出口側に主スワーラ23を備えている。

【0047】他方、外周筒15と冷却通路7との間に、メイン燃料ノズル20が装着され、このメイン燃料ノズル20はヘッドプレート16上に設置した燃料ヘッダ24に、燃料配管25を介して接続されている。なお、他の構成は、第3実施の形態(図3)と同様なのでその説明を省略する。

【0048】このような構成を有するガスタービン燃焼器1において、その起動時、パイロット燃料ノズル19およびメイン燃料ノズル20はともに高カロリー燃料、例えば灯油等の液体燃料または液化天然ガス等の気体燃料が使用され、起動運転が終了すると、低カロリー燃料が使用されるようになっている。

【0049】先ず、ガスタービン燃焼器1の起動時、燃料ヘッダ24から燃料配管25を介して分配された高カロリー燃料は、副燃焼室4dのパイロット燃料ノズル19に送給され、ここで副スワーラ22からの旋回流空気

が加わって燃焼ガスが生成され、さらに副燃焼室4dの出口側で主スワーラ23からの旋回流空気が加わって拡散燃焼にして燃焼ガスが生成されている。副燃焼室4dで生成された燃焼ガスが、一次燃焼域4aに拡散燃焼にして送給されるとき、冷却通路7から一次空気口11を経た冷却空気の一部により燃焼ガス温度が希釈化されるものの、二次燃焼域4cの燃焼ガスの保炎としての機能を果している。この間、燃焼器ライナ3は、一次燃焼域4aの燃焼ガスにより熱を受け、過酷な状態にあるが、冷却通路7の冷却作用によって安定した強度が保たれている。

【0050】他方、燃料ヘッダ24から燃料配管25を介してメイン燃料ノズル20に分配された高カロリー燃料は、冷却通路7からの冷却空気としての燃焼空気aにより希釈化され、燃料・空気の混合体としての予混合燃料となり、二次燃焼空気筒18から二次燃焼域4cに送給され、上記一次燃焼域4aの燃焼ガスにより予混合燃焼ガスが生成されるようになっている。

【0051】したがって、本実施の形態では、ガスタービン燃焼器1の起動終了まで高カロリーの燃料が使用されているが、メイン燃料ノズル20から二次燃焼域4cに予混合燃料が送給されているので、生成される燃焼ガスは低NO_x化を図ることができる。

【0052】また、起動運転終了後、燃料ヘッダ24は図示しない切替装置によって高カロリー燃料から低カロリー燃料に切り替わる。この場合、一次燃焼域4aは、燃料過濃状態で燃焼ガスが生成され、このため燃焼器ライナ3は燃焼ガスの熱を受け過酷な状態下にあるが、冷却通路7の冷却作用によりその強度の安全を保証することができる。そして、ガスタービン燃焼器1は、高カロリー燃料から低カロリー燃料に切り替わっても、その起動から定格までの全負荷域において、燃焼ガスの低NO_x化と相俟って燃焼ガスから受けける熱に抗して燃焼器ライナ3を保護することができる。

【0053】

【発明の効果】以上の通り、本発明に係るガスタービン燃焼器では、燃焼器ライナの一次燃焼域に沿って冷却通路を設けているので、冷却通路の冷却作用により一次燃焼域の燃焼ガスの熱に抗して燃焼器ライナを保護することができます。

【0054】また、冷却通路には、隆起部を設けて冷却空気の流れに乱を与え対流冷却効果を増しているので、冷却性能は今以上に向上させることができます。

【0055】また、冷却通路は、噴口部を設けて冷却空気の噴流衝突によるインピング冷却ができる構成になっているので、上記対流冷却よりも高い冷却性能を得ることができます。

【0056】さらにまた、冷却通路は、燃料空気通路部

からの冷却空気を、冷却空気導入口を介して增速し熱伝達率を高める一方、隆起部による冷却空気の乱流作用により熱伝達率を重畠させる構成になっている。したがって冷却通路の冷却効果は、今以上に向上させることができ。また、冷却通路は、その冷却空気で燃焼器ライナを冷却する際、加温され、その加温された冷却空気を反転させて二次燃焼域に案内する構成になっているので、二次燃焼域での燃焼ガス生成の際の冷却空気を予熱する必要がなく好都合である。

【0057】さらにまた、本発明に係るガスタービン燃焼器では、一次燃焼域の上流側に副燃焼室を設け、この副燃焼室にパイロット燃料ノズルを装着し、冷却通路と外周筒との間にメイン燃料ノズルを設け、一次燃焼域でパイロメット燃料ノズルからの噴出する燃料による燃焼ガスを保炎として機能させ、メイン燃料ノズルからの燃料による燃焼ガスをガスタービン作動ガスとする、二段燃焼方式になっており、また一次燃焼域に沿って冷却通路を設けた構成になっているので、燃料が高カロリー燃料から低カロリー燃料に切り替わっても燃焼ガスの低NO_x化とともに、燃焼ガスの熱に対して燃焼器ライナを保護することができる。

【図面の簡単な説明】

【図1】本発明に係るガスタービン燃焼器の一実施の形態を示す概略図。

【図2】本発明に係るガスタービン燃焼器の他の実施の形態を示す概略図。

【図3】本発明に係るガスタービン燃焼器の他の別の実施の形態を示す概略図。

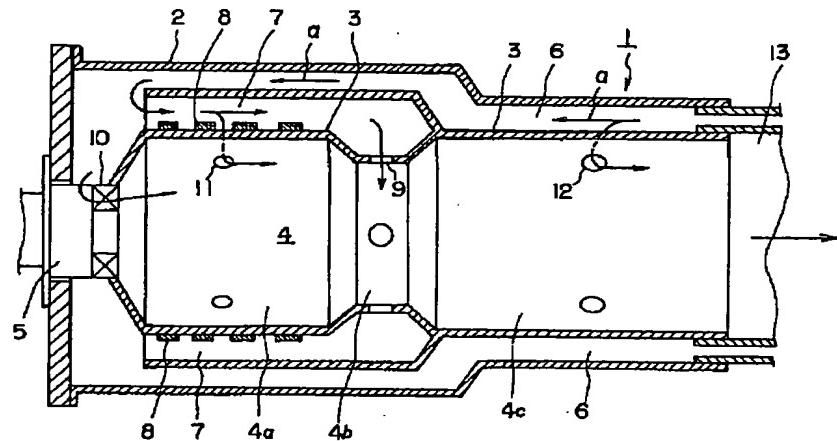
【図4】本発明に係るガスタービン燃焼器のさらに他の別の実施の形態を示す概略図。

【図5】従来のガスタービン燃焼器を示す概略図。

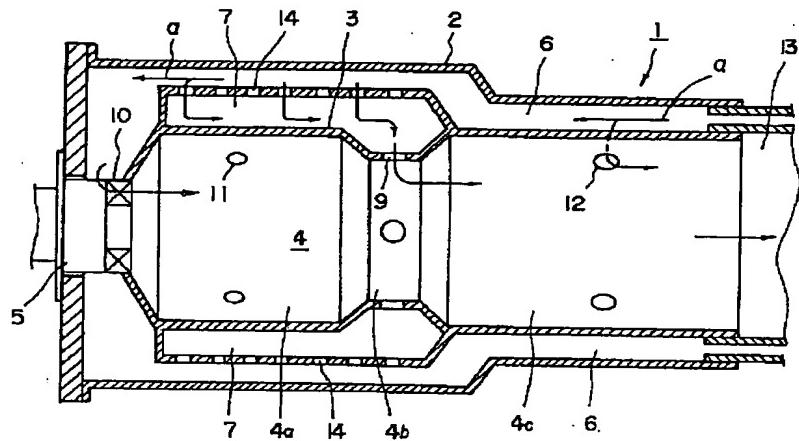
【符号の説明】

- 1 ガスタービン燃焼器
- 2 フロースリーブ
- 3 燃焼器ライナ
- 4 燃焼室
- 4a 一次燃焼域
- 4b 絞り部
- 4c 二次燃焼域
- 4d 副燃焼室
- 7 冷却通路
- 8 隆起部
- 14 噴口部
- 15 外周筒
- 16 ヘッドプレート
- 17 二次燃焼空気筒
- 19 パイロット燃料ノズル
- 20 メイン燃料ノズル

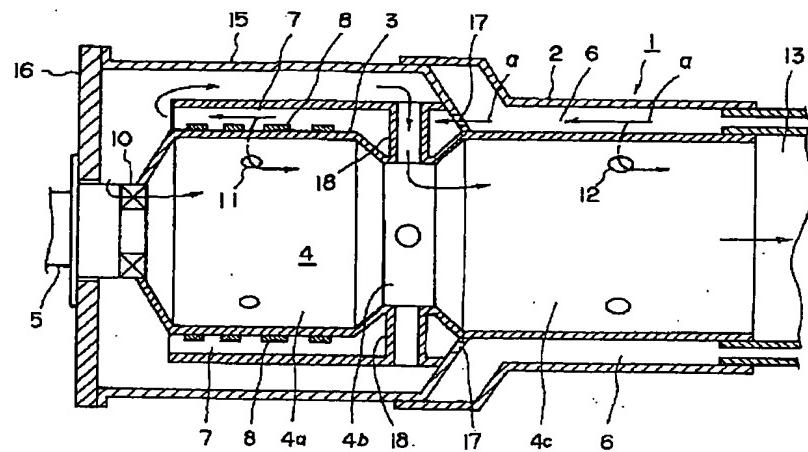
【図1】



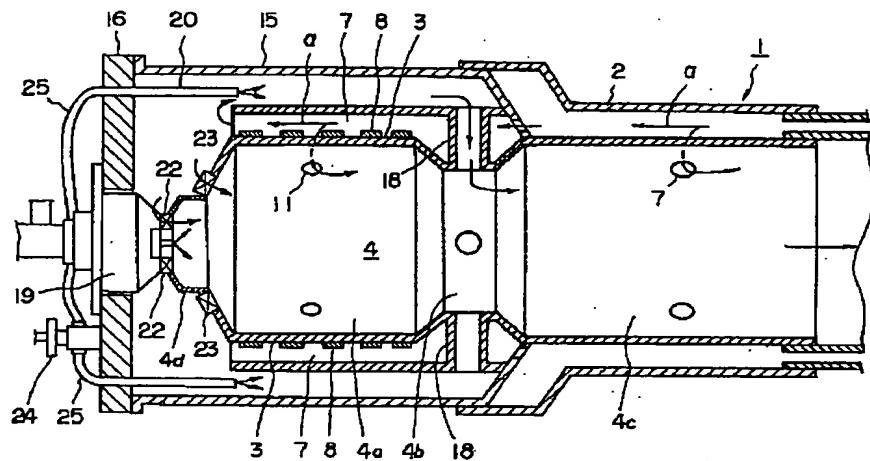
【図2】



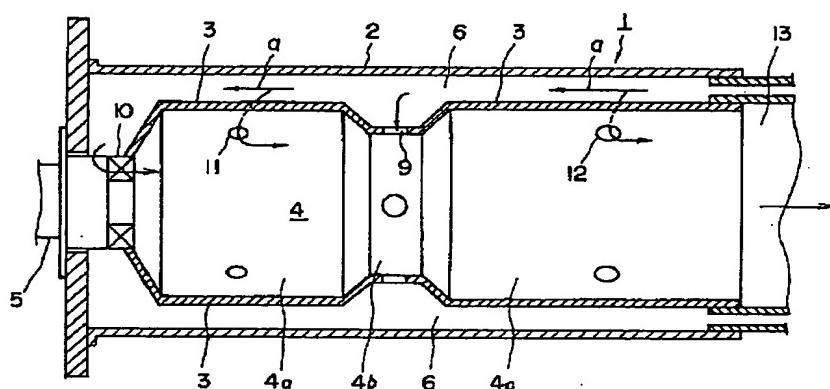
【図3】



【図4】



【図5】



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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-145057
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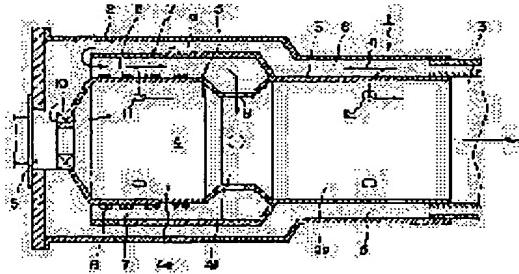
(21)Application number : 07-302738 (71)Applicant : TOSHIBA CORP
(22)Date of filing : 21.11.1995 (72)Inventor : ONODA AKIHIRO
YAMADA MASAHIKO

(54) GAS TURBINE COMBUSTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To effectually achieve cooling when low calorie combustion is used, and securely protect a combustor liner and hence effectually reduce NOx by providing a cooling passage for closing in the form of a blind alley a downstream end side along a primary combustion region of the combustor liner and opening an upstream end side.

SOLUTION: A gas turbine combustor 1 includes a flow sleeve 2 and a combustor liner 3 accommodated axially in the former, and further a combustion chamber 4 formed in the liner 3. It further includes a combustion nozzle 5 mounted on a head of the liner 3, from which a fuel is injected toward a primary combustion region 4a. A combustion air passage 6 is formed between the sleeve 2 and the liner 3 for guiding high pressure air from a compressor. In this case, a cooling passage 7 is provided which closes in the form of a blind alley a downstream end side along the primary combustion region 4a and opens an upstream end side. The passage 7 extends up to a drawing part 4b to derive the combustion air to the secondary combustion region 4c from there. Hereby, the liner 3 is effectually cooled.



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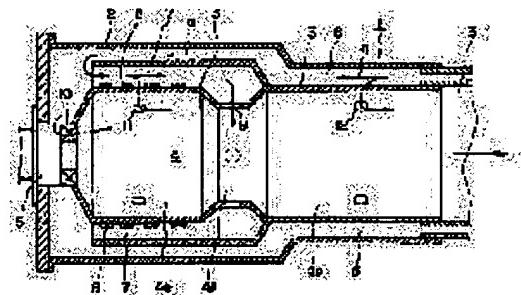
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CLAIMS

[Claim(s)]

[Claim 1] A primary combustion zone which has a flame tube held in same axle in a flow sleeve, and burns in the state of fuel **** sequentially from the upstream of this flame tube While forming a secondary combustion region which burns in the fuel thin condition, it is a cross sectional area smaller than a cross sectional area of each combustion zone among both [these] combustion zones. It is the gas turbine combustor equipped with the above, and along with a primary combustion zone of the above-mentioned flame tube, down-stream one end is plugged up in the shape of a cul-de-sac street, and it is characterized by preparing a cooling path which carries out the opening of upper one end.

[Claim 2] A gas turbine combustor according to claim 1 characterized by protruding a ridge on a round wall surface side at least in by the side of internal both peripheries wall surface of a cooling path.

[Claim 3] A primary combustion zone which has a flame tube held in same axle in a flow sleeve, and burns in the state of fuel **** sequentially from the upstream of this flame tube While forming a secondary combustion region which burns in the fuel thin condition, it is a cross sectional area smaller than a cross sectional area of each combustion zone among both [these] combustion zones. It is the gas turbine combustor equipped with the above, and while plugging up upper one end and down-stream one end in the shape of a cul-de-sac street along with a primary combustion zone of the above-mentioned flame tube, it is characterized by establishing a cooling path which has the nozzle-hole section in a peripheral-wall side.

[Claim 4] A primary combustion zone which is characterized by providing the following and which has a flame tube held in same axle in a flow sleeve, and burns in the state of fuel *** sequentially from the upstream of this flame tube, A gas turbine combustor which drilled an airport which is equipped with a converging section which has a cross sectional area smaller than a cross sectional area of each combustion zone, and feeds a combustion air into this converging section in the above-mentioned secondary combustion region among both [these] combustion zones while forming a secondary combustion region which burns in the fuel thin condition A periphery cylinder which fixed other end side to a head plate while closing an end side in the shape of a cul-de-sac street along with a primary combustion zone and an upper converging section of the above-mentioned flame tube A cooling path which is held between this periphery cylinder and the above-mentioned flame tube, is open for free passage to a cooling air inlet which drilled an end side in a periphery cylinder with which it was closed in the shape of [above-mentioned] a cul-de-sac street, and carries out the opening of other end side A secondary-combustion-air cylinder which crosses to this cooling path and shows a combustion air to a secondary combustion region of the above-mentioned flame tube

[Claim 5] A gas turbine combustor characterized by protruding a ridge on a round wall surface side at least in by the side of internal both peripheries wall surface of a cooling path held between a periphery cylinder and a flame tube.

[Claim 6] A primary combustion zone which is characterized by providing the following and which has a flame tube held in same axle in a flow sleeve, and burns in the fuel overcrowded condition sequentially from the upstream of this flame tube, A gas turbine combustor which drilled an airport which is equipped with a converging section which has a cross sectional area smaller than a cross sectional area of each combustion zone, and feeds a combustion air into this converging section in the above-mentioned secondary combustion region among both [these] combustion zones while forming a secondary combustion region which burns in the fuel thin condition A periphery cylinder closed with a head plate in other end side while closing an end side in the shape of a cul-de-sac street along with a primary combustion zone and an upper converging section of the above-mentioned flame tube A cooling path which is held between this periphery cylinder and the above-mentioned flame tube, is open for free passage to a cooling air inlet which drilled an end side in a periphery cylinder with which it was closed in the shape of [above-mentioned] a cul-de-sac street, and carries out the opening of other end side A secondary-combustion-air cylinder which crosses to this cooling path and shows a combustion air to a secondary combustion region of the above-mentioned flame tube The Maine fuel nozzle which is prepared between a secondary combustion chamber formed in the upstream of a primary combustion zone of

the above-mentioned flame tube, a pilot fuel nozzle with which were prolonged even in this secondary combustion chamber and the above-mentioned head plate was equipped, and the above-mentioned periphery cylinder and the above-mentioned cooling path, and feeds a thin fuel into a secondary combustion region of the above-mentioned flame tube [Claim 7] A gas turbine combustor according to claim 6 characterized by equipping a secondary combustion chamber with a subswirler which gives a revolution style to a fuel spouted from a pilot fuel nozzle, and the main swirler which gives a revolution style to combustion gas which comes out of the above-mentioned secondary combustion chamber.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to a gas turbine combustion machine, and relates to a suitable gas turbine combustor to especially generate combustion gas using the fuel of low calorie content.

[0002]

[Description of the Prior Art] Generally, there are thermal NOx resulting from the nitrogen contained in a combustion air and fuel NOx resulting from the nitrogen contained in a fuel in the combustion gas generated from a gas turbine combustor. If many nitrogen, such as ammonia, is contained in the fuel, the ratio for NOx in combustion gas is especially high.

[0003] although many researches which change a low-calorie-content fuel, for example, coal, into a gasification condition, and are used for the fuel of a gas turbine combustor are recently advanced in this seed field in consideration of starvation of a fossil fuel -- anyway -- being also alike -- since much nitrogen content is contained in that fuel, reduction of fuel NOx is difficult.

[0004] As seen as this fuel NOx reduction technology in the reference of many foreign countries, for example, the reference of The American Society of Mechanical Engineers, 83-GT-14, and 83-GT-108 (all are the 1983 ASME issue) The Rich-Lean combustion method properly used comparatively in the secondary combustion region of a fuel thin condition with the primary combustion zone of a fuel **** condition in one combustion chamber, In case a secondary combustion chamber is newly prepared in a combustion chamber for the purpose of flame stabilizing and combustion gas is generated by this secondary combustion chamber, the technology which makes higher than before equivalent ratio (rate that the fuel quantity to the theoretical quantity of air occupies) is well known from the former.

[0005] however, carry out for a gas turbine combustor to adopt which combustion method of the above-mentioned Rich-Lean combustion method or the combustion method in a secondary combustion chamber -- if the fuel itself is low calorie content, in order to pull up to the same level as generating good combustion gas using a high calorie fuel, it is necessary to use a low-calorie-content fuel so much, and to change a part of combustion chamber into a fuel *** condition

[0006] However, since itself is elevated-temperature-ized in the case of combustion gas generation when changing a part of combustion chamber into the fuel *** condition, the cooling technology of a combustion chamber in which high **-ization was coped with is searched for.

[0007] Drawing 5 is the schematic diagram showing the gas turbine combustor in consideration of cooling of a combustion chamber.

[0008] A sign 1 shows a gas turbine combustor. this gas turbine combustor 1 supplies the combustion gas which is located between the compressors and gas turbines which are not, the fuel was added to high-pressure air from the compressor, generates combustion gas, and was generated to a gas turbine through the transition piece 13 as working medium a drawing example.

[0009] The gas turbine combustor 1 is equipped with the tubed flow sleeve 2 and the tubed flame tube 3 held in this in same axle as shown in drawing 5.

[0010] The tubed flame tube 3 forms a combustion chamber 4 in the interior. It has the composition of having primary combustion-zone 4a which generates combustion gas under a fuel overcrowded condition sequentially from the upstream of this combustion chamber 4, secondary combustion region 4c which generates combustion gas under a fuel thin condition, and drawing part 4b of a cross sectional area smaller than the cross sectional area of both [these] the combustion zones 4a and 4c.

[0011] Moreover, to the head side of a flame tube 3, it is equipped with a fuel nozzle 5, a low-calorie-content fuel is

mixed from here from a swirler 10 to revolution air, and it is blowing off toward primary combustion-zone 4a as combustion gas.

[0012] between the above-mentioned flow sleeve 2 and the above-mentioned flame tube 3, the combustion-air path 6 to which it shows the high-pressure air from the compressor which is not a drawing example is formed.

[0013] In the gas turbine combustor 1 of such a configuration, the high-pressure air guided at the combustion-air path 6 is used as the combustion air of combustion gas generation, and cooling air of a flame tube 3.

[0014] Namely, a combustion air among the high-pressure air guided at the combustion-air path 6 Like the illustration continuous line arrow head a while progressing toward the upstream of primary combustion-zone 4a Are used in order to lower the temperature of combustion to the temperature suitable for the working medium of a gas turbine in the diluting-air opening 12 of secondary combustion region 4c, and it sets to the secondary air opening 9 of converging section 4b. Are used in order to urge combustion of an unburnt fuel, and it sets to the primary air inlet 11 of primary combustion-zone 4a further. It was used for the ** sake to which combustion of a **** fuel is urged, and in order to give and atomize a revolution style from a fuel nozzle 5 to a fuel in the swirler 10 of a primary combustion-zone 4a head further again, it was used, respectively. On the other hand, the combustion air a flowed along with the wall surface of a flame tube 3, it was used in order to protect the flame tube 3 under a heating condition, and it was cooled and protected by convection-current cooling etc.

[0015]

[Problem(s) to be Solved by the Invention] By the way, aiming at high temperature increase in efficiency, as for the latest gas turbine, it gropes for elevated-temperature-ization of the temperature of combustion of a gas turbine combustor as part of that. If it is the source of a combustion air restricted with the gas turbine combustor with elevated-temperature-izing of combustion gas, the rate of occupying to use of cooling air required to put specific gravity on use of a combustion air required to urge generation of the above-mentioned combustion gas, and cool a flame tube will decrease. It is difficult to protect the flame tube which needs a lot of [in order to maintain on the same level as the temperature of combustion of the gas turbine combustor which uses a high calorie fuel in the gas turbine combustor which uses a low-calorie-content fuel] fuels, an amount of combustible air required for generation of combustion gas also increases in connection with this, and the amount of cooling air especially falls in inverse proportion to this increment, and is in the above-mentioned heating condition under this lowered amount of cooling air.

[0016] Moreover, even if it is the gas turbine combustor which uses a low-calorie-content fuel, many NOx is contained in the combustion gas generated during use of this high calorie fuel although high calorie fuels, such as kerosene, gas oil, and LNG, are used from the stability of combustion gas generation to starting operation termination. Although water or a steam is injected from the former as this NOx reduction measure to the fuel spouted from a fuel nozzle and he was trying to lower the temperature of combustion under generation, considering the thermal efficiency of the whole electric power plant within a station, it cannot be economically said to be a best policy on the relation which uses a lot of water or steams.

[0017] this invention is made in view of such a situation -- also having -- it aims at offering the gas turbine combustor which was that of **, and aimed at effective reduction of NOx contained in generation combustion gas while protecting certainly by performing effective cooling under the source of cooling air to which the flame tube exposed to a heating condition more than now was restricted, when a low-calorie-content fuel was used.

[0018]

[Means for Solving the Problem] A primary combustion zone which has a flame tube held in same axle in a flow sleeve, and burns in the state of fuel **** sequentially from the upstream of this flame tube in order that a gas turbine combustor concerning this invention may attain the above-mentioned purpose, While forming a secondary combustion region which burns in the fuel thin condition, among both [these] combustion zones In a gas turbine combustor which drilled an airport which is equipped with a converging section which has a cross sectional area smaller than a cross sectional area of each combustion zone, and feeds a combustion air into this converging section in the above-mentioned secondary combustion region Along with a primary combustion zone of the above-mentioned flame tube, down-stream one end is plugged up in the shape of a cul-de-sac street, and a cooling path which carries out the opening of upper one end is prepared.

[0019] A primary combustion zone which a gas turbine combustor concerning this invention has a flame tube held in same axle in a flow sleeve, and burns in the state of fuel **** sequentially from the upstream of this flame tube, While forming a secondary combustion region which burns in the fuel thin condition, among both [these] combustion zones In a gas turbine combustor which drilled an airport which is equipped with a converging section which has a cross sectional area smaller than a cross sectional area of each combustion zone, and feeds a combustion air into this converging section in the above-mentioned secondary combustion region While plugging up upper one end and down-

stream one end in the shape of a cul-de-sac street along with a primary combustion zone of the above-mentioned flame tube, a cooling path which has the nozzle-hole section is established in a peripheral-wall side.

[0020] A primary combustion zone which a gas turbine combustor concerning this invention has a flame tube held in same axle in a flow sleeve, and burns in the state of fuel **** sequentially from the upstream of this flame tube, While forming a secondary combustion region which burns in the fuel thin condition, among both [these] combustion zones In a gas turbine combustor which drilled an airport which is equipped with a converging section which has a cross sectional area smaller than a cross sectional area of each combustion zone, and feeds a combustion air into this converging section in the above-mentioned secondary combustion region While closing an end side in the shape of a cul-de-sac street along with a primary combustion zone and an upper converging section of the above-mentioned flame tube A cooling path which is held between a periphery cylinder which fixed other end side to a head plate, and this periphery cylinder and the above-mentioned flame tube, is open for free passage to a cooling air inlet which drilled an end side in a periphery cylinder with which it was closed in the shape of [above-mentioned] a cul-de-sac street, and carries out the opening of other end side, It is made a configuration which has a secondary-combustion-air cylinder which crosses to this cooling path and shows a combustion air to a secondary combustion region of the above-mentioned flame tube.

[0021] A primary combustion zone which a gas turbine combustor concerning this invention has a flame tube held in same axle in a flow sleeve, and burns in the fuel overcrowded condition sequentially from the upstream of this flame tube, While forming a secondary combustion region which burns in the fuel thin condition, among both [these] combustion zones In a gas turbine combustor which drilled an airport which is equipped with a converging section which has a cross sectional area smaller than a cross sectional area of each combustion zone, and feeds a combustion air into this converging section in the above-mentioned secondary combustion region While closing an end side in the shape of a cul-de-sac street along with a primary combustion zone and an upper converging section of the above-mentioned flame tube A cooling path which is held between a periphery cylinder closed with a head plate in other end side, and this periphery cylinder and the above-mentioned flame tube, is open for free passage to a cooling air inlet which drilled an end side in a periphery cylinder with which it was closed in the shape of [above-mentioned] a cul-de-sac street, and carries out the opening of other end side, A secondary-combustion-air cylinder which crosses to this cooling path and shows a combustion air to a secondary combustion region of the above-mentioned flame tube, A secondary combustion chamber formed in the upstream of a primary combustion zone of the above-mentioned flame tube, and a pilot fuel nozzle with which were prolonged even in this secondary combustion chamber and the above-mentioned head plate was equipped, It is prepared between the above-mentioned periphery cylinder and the above-mentioned cooling path, and considers as a configuration which has the Maine fuel nozzle which feeds a thin fuel into a secondary combustion region of the above-mentioned flame tube.

[0022]

[Embodiment of the Invention] Hereafter, drawing 1 explains the gestalt of 1 operation of the gas turbine combustor concerning this invention.

[0023] A sign 1 shows a gas turbine combustor. It is located between the compressors and gas turbines which are not illustrated, a fuel is added to high-pressure air from a compressor, and this gas turbine combustor 1 generates combustion gas. The combustion gas generated with the gas turbine combustor 1 is guided at a gas turbine, does expansion work by the paragraph section which consists of a stationary blade and a bucket here, and obtains rotational energy.

[0024] The gas turbine combustor 1 is equipped with the flow sleeve 2 and the flame tube 3 held in this in same axle as shown in drawing 1.

[0025] A flame tube 3 forms a combustion chamber 4 in the interior. This combustion chamber 4 has the composition of having primary combustion-zone 4a which generates combustion gas under a fuel **** condition sequentially from the upstream, secondary combustion region 4c which generates combustion gas under a fuel thin condition, and converging section 4b of a cross sectional area smaller than the cross sectional area of both [these] the combustion zones 4a and 4c.

[0026] Moreover, to the head side of a flame tube 3, it is equipped with a fuel nozzle 5 and the low-calorie-content fuel, for example, a coal gasification fuel, is blowing off from here toward primary combustion-zone 4a.

[0027] the cooling path 7 which the combustion-air path 6 to which it shows the high-pressure air from the compressor which is not a drawing example is formed between the above-mentioned flow sleeve 2 and the above-mentioned flame tube 3, and is in this combustion-air path 6, plugs up down-stream one end in the shape of a cul-de-sac street along with primary combustion-zone 4a of the above-mentioned flame tube 3, and carries out the opening of upper one end -- preparing -- *****.

[0028] The cooling path 7 extended to converging section 4b of a flame tube 3, and is equipped with the secondary air opening 9 by the side of internal both the peripheries wall surface to which it is open for free passage to down-stream one end at the above-mentioned converging section 4b, and shows a combustion air at the above-mentioned secondary combustion region 4c while equipping a round wall surface side with a ridge 8 at least in the meantime.

[0029] In the gas turbine combustor 1 equipped with the above-mentioned cooling path 7, a low-calorie-content fuel blows off from a fuel nozzle 5 toward primary combustion-zone 4a, the combustion air from a swirler 10 joins the fuel which blew off, a revolution style is given, the combustion air from a primary air inlet 11 is added further, and combustion gas is generated.

[0030] However, in primary combustion-zone 4a, since combustion gas is generated in the state of fuel *****, the inside-and-outside periphery wall surface of the flame tube 3 which forms primary combustion-zone 4a receives the heat of elevated-temperature combustion gas directly, and is exposed to the severe condition.

[0031] The combustion air a as cooling air fed through the combustion-air path 6 from the compressor which is not illustrated is guided at the cooling path 7, and he makes it collide by the ridge 8, and is trying to take the heat from a flame tube 3 in the flame tube 3 under such a condition, by convection-current cooling which gave turbulence to the flow, as shown by the illustration continuous line arrow head. and the combustion air a which took the heat from a flame tube 3 should pass converging section 4b from the secondary air opening 9 -- show around at secondary combustion region 4c, and pass the diluting-air opening 12 from the combustion-air path 6 here -- generate low-temperature combustion gas comparatively with the combustion air as guided cooling air, and pass the transition piece 13 in generation combustion gas -- it is fed by the gas turbine which is not a drawing example.

[0032] Therefore, in the gas turbine combustor 1 concerning the gestalt of this operation, even if it is the flame tube 3 exposed to elevated-temperature combustion gas although primary combustion-zone 4a uses a low-calorie-content fuel and it is in a fuel ***** condition therefore, by the cooling path 7, since a ridge 8 can be made to be able to cause convection-current cooling again and the heat of a flame tube 3 can be taken, the *** reinforcement of the flame tube 3 can fully be maintained, and elevated-temperature combustion gas can be generated.

[0033] Drawing 2 is the schematic diagram showing the gestalt of other operations of the gas turbine combustor concerning this invention.

[0034] The gestalt of this operation is replaced with convection-current cooling of the cooling path 7 which is the gestalt of the 1st operation, and can be made to perform in PINJI cooling.

[0035] If it explains in full detail, this cooling path 7 will be made into the locked-up room which plugs up upper one end and down-stream one end in the shape of a cul-de-sac street along with primary combustion-zone 4a of a flame tube 3, and will form the nozzle-hole section 14 in the peripheral-wall side side of this locked-up room. In addition, since other configurations are the same as that of the gestalt of the 1st operation, the explanation is omitted.

[0036] At the cooling path 7 equipped with the above-mentioned nozzle-hole section 14, the combustion air a as cooling air from the combustion-air path 6 carried out the jet collision (in PINJI) to the wall surface of a flame tube 3 through the nozzle-hole section 14, and has taken the heat of a flame tube 3 in the case of a jet collision. And the combustion air a which took the heat of a flame tube 3 is warmed, and secondary combustion region 4c is presented with it through the secondary air opening 9 of converging section 4b from here.

[0037] Thus, at the cooling path 7, since in PINJI cooling called the jet collision of a combustion air a is performed, the cooling engine performance can improve at the point that a heat transfer rate is higher than convection-current cooling which is the gestalt of the 1st operation, and the *** reinforcement of a flame tube 3 can be maintained certainly.

[0038] Drawing 3 is the schematic diagram showing the gestalt of other another operations of the gas turbine combustor concerning this invention.

[0039] The gestalt of this operation differs from the gestalt of the 1st operation directly at the point which it shows to the cooling path 7, without bypassing the combustion air a as cooling air from the combustion-air path 6.

[0040] That is, as shown also in drawing, the periphery cylinder 15 is formed along with primary combustion-zone 4a and converging section 4b of a flame tube 3. This periphery cylinder 15 is the tubed thing which was closed in the shape of a cul-de-sac street in the end side, and fixed other end side to the head plate 16.

[0041] The cooling path 7 in alignment with primary combustion-zone 4a and converging section 4b of a flame tube 3 is held in this tubed periphery cylinder 15 in same axle, and this cooling path 7 is open for free passage with the combustion-air path 6 with the cooling air inlet 17 drilled in the periphery cylinder 15 with which it was closed in the shape of [above-mentioned] a cul-de-sac street. Moreover, the ridge 8 protrudes on the 1 wall-surface side at least in by the side of internal both the wall surface at the cooling air path 7. Moreover, the secondary-combustion-air cylinder 18 to which the cooling air which cooled the wall surface of a flame tube 3 is detoured, and it shows secondary combustion region 4c is formed in the cooling path 7 across boundaries.

[0042] It shows around through the cooling air inlet 17 by making the combustion air a as cooling air from the combustion-air path 6 into cooling air, and convection-current cooling to which ** of the flow by interference with a ridge 8 is urged here is made, after cooling the wall surface of a flame tube 3, it is reversed and such a cooling path 7 of a passage configuration is supplied to secondary combustion region 4c from the secondary-combustion-air cylinder 18. [0043] therefore, at this cooling path 7, when using the combustion air a from the combustion-air path 6 as cooling air, it accelerates in the cooling air inlet 17, and a heat transfer rate increases, further, a heat transfer rate can be markedly alike with a turbulent flow operation of a ridge 8, it can improve, and wall surface cooling of a flame tube 3 can be cooled highly much more.

[0044] Drawing 4 is the schematic diagram showing the gestalt of other another operations of the gas turbine combustor concerning this invention.

[0045] By equipping 4d of this secondary combustion chamber with the pilot fuel nozzle 19, the gestalt of this operation operates the combustion gas of primary combustion-zone 4a in flame stabilizing, and forms the Maine fuel nozzle 20 between the periphery cylinder 15 and the cooling path 7, and feeds the premixed fuel as a mixture which added air to the fuel at secondary combustion region 4c while it prepares 4d of secondary combustion chambers in the upstream of primary combustion-zone 4a.

[0046] That is, 4d of secondary combustion chambers is prepared in the upstream of primary combustion-zone 4a. 4d of this secondary combustion chamber has the space section formed in abbreviation box-like, and it can equip now with the pilot fuel nozzle 19 held on the head plate 16. Moreover, they equip the outlet side of the subswirler 22 with the main swirler 23 while 4d of secondary combustion chambers forms the subswirler 22 in the periphery side of the pilot fuel nozzle 19.

[0047] On the other hand, it is equipped with the Maine fuel nozzle 20 between the periphery cylinder 15 and the cooling path 7, and this Maine fuel nozzle 20 is connected to the fuel header 24 installed on the head plate 16 through the fuel line 25. In addition, since other configurations are the same as that of the gestalt (drawing 3) of the 3rd operation, the explanation is omitted.

[0048] In the gas turbine combustor 1 which has such a configuration, after, as for both the pilot fuel nozzle 19 and the Maine fuel nozzle 20, gaseous fuel, such as liquid fuel, such as a high calorie fuel, for example, kerosene etc., or liquefied natural gas, is used at the time of the starting and starting operation is completed, a low-calorie-content fuel is used.

[0049] First, at the time of starting of the gas turbine combustor 1, the high calorie fuel distributed through the fuel line 25 from the fuel header 24 is fed into the pilot fuel nozzle 19 of 4d of secondary combustion chambers, the revolution style air from the subswirler 22 is added here, combustion gas is generated, the revolution style air from the main swirler 23 is further added by the outlet side of 4d of secondary combustion chambers, it is made diffusive burning, and combustion gas is generated. Although a part of cooling air which passed through the primary air inlet 11 from the cooling path 7 dilutes in the temperature of combustion when the combustion gas generated by 4d of secondary combustion chambers makes it diffusive burning and is fed into primary combustion-zone 4a, the function as flame stabilizing of the combustion gas of secondary combustion region 4c is achieved. In the meantime, although a flame tube 3 receives heat by the combustion gas of primary combustion-zone 4a and is in a severe condition, the reinforcement stabilized according to a cooling operation of the cooling path 7 is maintained.

[0050] On the other hand, the combustion air a as cooling air from the cooling path 7 dilutes, the high calorie fuel distributed to the Maine fuel nozzle 20 through the fuel line 25 from the fuel header 24 turns into premixed fuel as a mixture of a fuel and air, it is fed into secondary combustion region 4c from the secondary-combustion-air cylinder 18, and premixed combustion gas is generated by the combustion gas of the above-mentioned primary combustion-zone 4a.

[0051] Therefore, with the gestalt of this operation, although the fuel of a high calorie is used till starting termination of the gas turbine combustor 1, since premixed fuel is fed into secondary combustion region 4c from the Maine fuel nozzle 20, the combustion gas generated can attain low NOx-ization.

[0052] Moreover, the fuel header 24 changes from a high calorie fuel to a low-calorie-content fuel with the transfer device which is not illustrated after starting operation termination. In this case, although, as for primary combustion-zone 4a, combustion gas is generated in the state of fuel ****, a flame tube 3 receives the heat of combustion gas for this reason and it is under a severe condition, the safety of the reinforcement of **** can be guaranteed according to a cooling operation of the cooling path 7. And even if the gas turbine combustor 1 changes from a high calorie fuel to a low-calorie-content fuel, in the full load region from the starting to rating, it can resist the reduction in NOx of combustion gas, and the heat conjointly received from combustion gas, and can protect a flame tube 3.

[0053]

[Effect of the Invention] Since the cooling path is prepared along with the primary combustion zone of a flame tube

with the gas turbine combustor concerning this invention as above, the heat of the combustion gas of a primary combustion zone can be resisted according to a cooling operation of a cooling path, and a flame tube can be protected. [0054] Moreover, since a ridge is prepared in a cooling path, ** is given to the flow of cooling air and the convection-current cooling effect is increased, the cooling engine performance can be raised more than now.

[0055] Moreover, since the cooling path has composition which prepares the nozzle-hole section and can perform in PINJI cooling by the jet collision of cooling air, the cooling engine performance higher than the above-mentioned convection-current cooling can be obtained.

[0056] While a cooling path accelerates the cooling air from the fuel air duct section through a cooling air inlet and raises a heat transfer rate, it has composition on which a heat transfer rate is made to superimpose according to a turbulent flow operation of the cooling air by the ridge further again. Therefore, the cooling effect of a cooling path can be raised more than now. Moreover, since a cooling path has composition which is warmed, is made to reverse the warmed cooling air, and it shows to a secondary combustion region in case it cools a flame tube by the cooling air, it does not need to heat beforehand the cooling air in the case of combustion gas generation in a secondary combustion region, and is convenient.

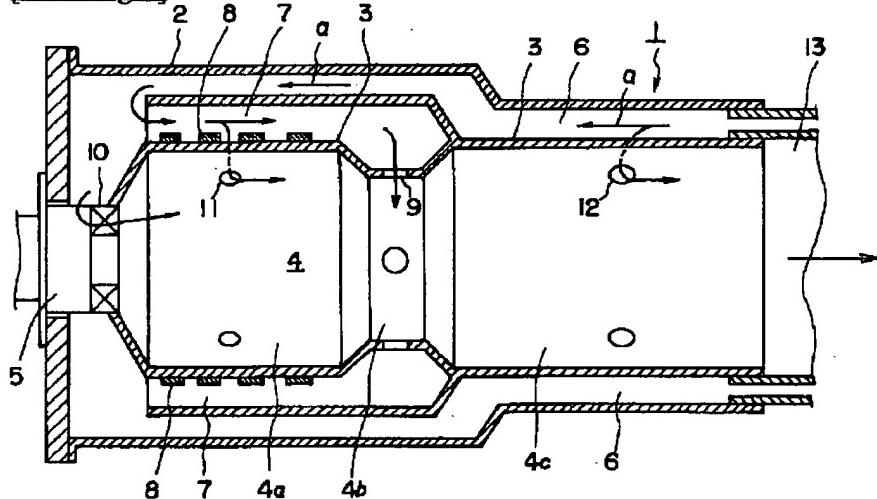
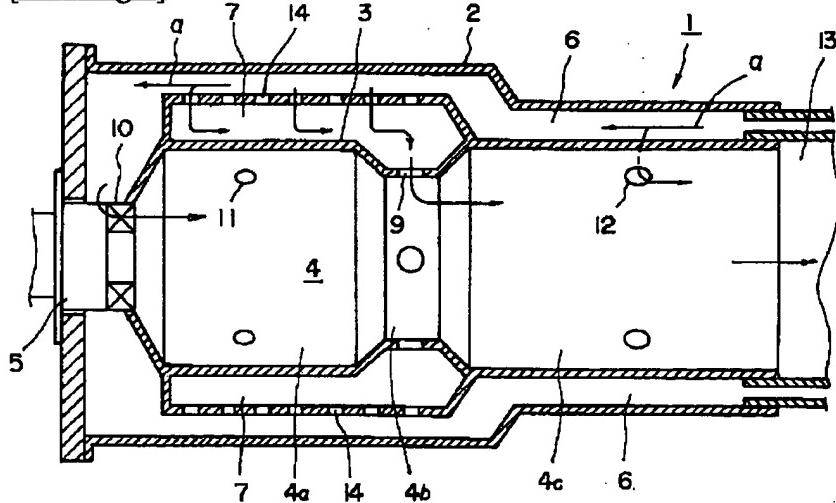
[0057] With the gas turbine combustor concerning this invention further again Prepare a secondary combustion chamber in the upstream of a primary combustion zone, and this secondary combustion chamber is equipped with a pilot fuel nozzle. Prepare the Maine fuel nozzle between a cooling path and a periphery cylinder, and the combustion gas by the fuel spouted from the Pye Romet fuel nozzle by the primary combustion zone is operated as flame stabilizing. Since it has the composition which makes the combustion gas by the fuel from the Maine fuel nozzle gas turbine working medium of being a two-stage burning system and having prepared the cooling path along with the primary combustion zone Even if a fuel changes from a high calorie fuel to a low-calorie-content fuel, a flame tube can be protected to the heat of combustion gas with low NOx-ization of combustion gas.

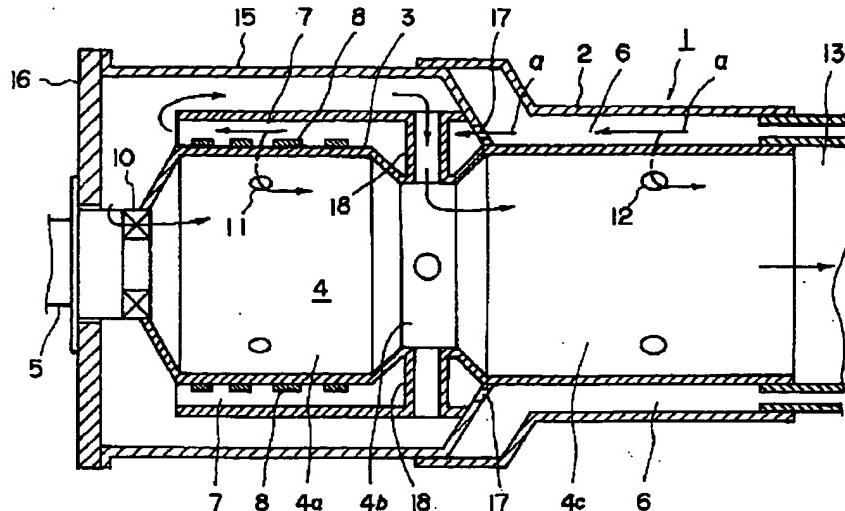
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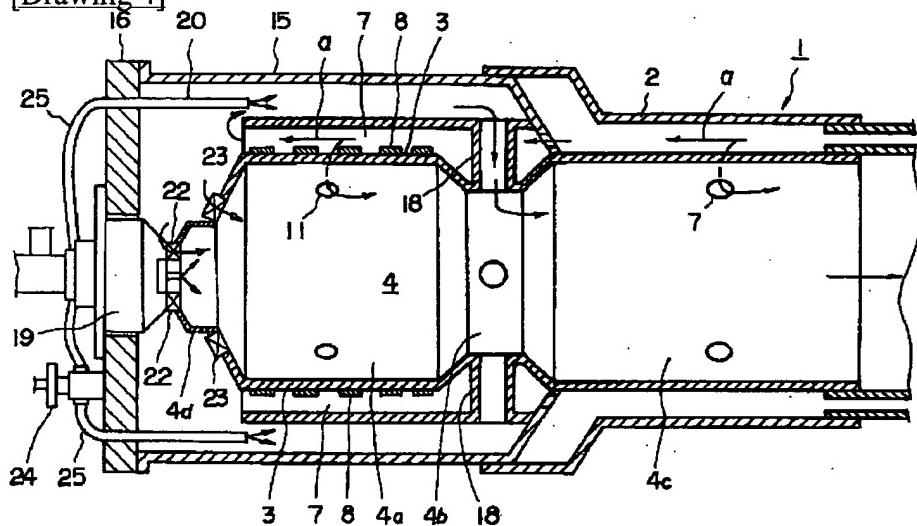
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2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

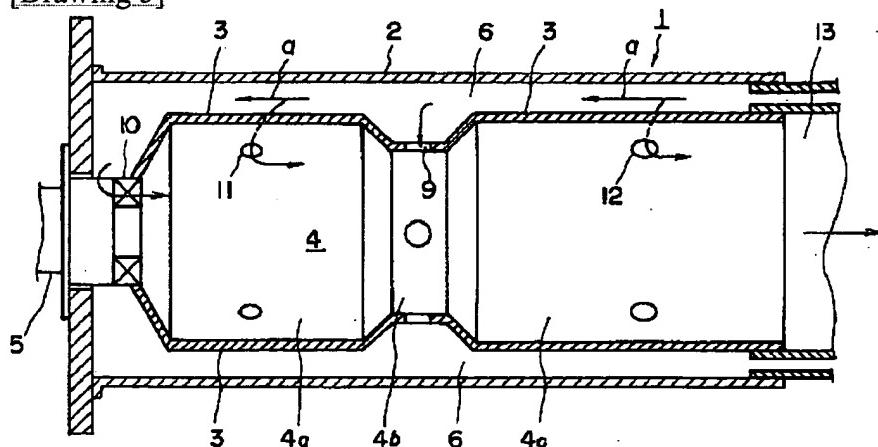
DRAWINGS**[Drawing 1]****[Drawing 2]****[Drawing 3]**



[Drawing 4]



[Drawing 5]



[Translation done.]